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(54) PROCESS FOR MANUFACTURING BISCUITS

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A B S T R A C T

Process for the manufacture of biscuits. The process comprises (i) melting togothor (a) 1 part by weight of edible fat which melts in the range of 28 to 40°C, and (b) 0.03 to 0.2 part by weight of crude lecithin obtained from soya beans and/or vegetable phosphatides chemically related thereto. 1.5 To 4 parts by weight of dry powdered protein obtained from foodstuffs, with a protein content raised by purification to at least 60 per cent by weight - relative to solids - and concentrated to a carbohydrate content of 5 to 35 per cent by weight-relative to solids - and has as far as possible been left in its natural structure and (d) a total of 0.1 to 1 part by weight - relative to solids - of additives containing mineral salts, flavouring substances and/or vitamins are mixed into the melt. The mixture is rendered thixotropically capable of flow and homogeneous by kneading whilst warming to a temperature of 28 to 50°C. The mixture is then shaped whilst still capable of flow and hardened by being left to stand whilst cooling.

The invention relates to a process for the manufacture of biscuits from a foodstuff mixture containing fats, proteins, carbohydrates and additives, by shaping the warm mixture, which is capable of flow, and subsequently hardening it whilst it is cooling, and to biscuits which are manufactured by this process.

Metabolic disturbances and obesity are frequently due to an excess of carbohydrates and an inadequate amount of protein in the food provided. This can be counteracted by providing foodstuffs of minimum carbohydrate content and high protein content, without excessive fat content. Experience has shown that foodstuff granules of such composition, if taken in amounts which suffice for the desired compensation in cases of obesity, cause revulsion so that - at least from a long-term point of view - the prospects of successfully reducing the proportion of carbohydrate in the total foodstuffs provided, through using such granules, does not look hopeful. Granules cannot be chewed and can only be ground between the teeth, and this is one reason for the lack of enjoyment of such granules.

It is the task of the invention to provide a foodstuff which has a relatively high protein content, a low fat content and a minimum carbohydrate content and can be chewed and is pleasant to consume, even if it is taken frequently in amounts which suffice to replace a daily main meal.

According to the process of the invention, this task is solved if (a) 1 part by weight of edible fat which melts in the range of 28 to 40 degrees centigrade, (b) 0.03 to 0.2 part by weight of crude lecithin obtained from soya beans and/or vegetable phosphatides chemically related thereto, and (c) 1.5 to 4 parts by weight of powdered protein obtained from foodstuffs are melted together. The protein content of (c) has been raised by purification to at least 60 per cent by weight, relative to solids. (c) Has been concentrated to a carbohydrate content of 5 to 35 per cent by weight - relative to solids - and is dry and has, as far as possible, been left in its natural structure. A total of 0.1 to 1 part by weight-relative to solids - of additives containing mineral salts, flavouring substances and/or vitamins are mixed into the above melt. The mixture is rendered thixotropically capable of flow and is

homogenised, by kneading whilst warming to a temperature of 28 to 50 degrees centigrade. The mixture is shaped whilst still capable of flow and is hardened by leaving it to stand whilst cooling.

The process according to the invention produces biscuits of a mixture that contains fats, proteins, carbohydrates and additives. The biscuit can be chewed at room temperature and breaks on chewing. It is in the form of a thixotropically consolidated gel of which the dispersing agent has also solidified on cooling. The biscuit contains the following, homogeneously distributed: 0.03 to 0.2 part by weight of crude lecithin obtained from soya beans and/or vegetable phosphatides chemically related thereto, 0.9 to 2.4 parts by weight of protein, at most 1.4 parts by weight of carbohydrates and a total of 0.1 to 1 part by weight of additives, containing nutrient salts, flavouring substances and/or vitamins, per 1 part by weight of edible fat, melting in the range of 28 to 40 degrees centigrade.

The biscuits manufactured according to the process of the invention can be bitten or chewed. They break in a crisp fashion when vigorously bitten by human teeth. In the case of known bars of chocolate which can be chewed, the strength which allows the material to be chewed is due to the very high content of fats which are hard at room temperature. The fat content of chocolate bars is 60 per cent by weight or more. With known biscuits made of glucose this necessary strength is based on the binding capacity of the sugar brought about by compression of the glucose. The binding capacity of sugar cannot be utilized for the process according to the invention, at least not to a significant extent, because of the desired minimum content of carbohydrates. The internal strength structure of chocolate is also unsuitable for the invention because it is based on a high content of carbohydrate and fat, and it is just these which the invention seeks to avoid.

According to the invention the desired strength which brings about the ability to bite or chew the material is achieved by using a low carbohydrate content and fat content. The surprisingly high strength of the hardened mixture and its ability to be chewed, which can be achieved at the comparatively high protein content according to the invention, is due to the following

circumstances.

The mixture to be shaped is thixotropic, at least when its fat content and lecithin content has been melted by warming. As a result of the pressures exerted during vigorous stirring or kneading, the mass becomes a sol capable of flow, and the fat constituent and the lecithin constituent in the molten state form the liquid dispersing agent. If the pressure exerted is relaxed, the mixture solidifies, like any thixotropic mixture, to a solid gel after some time. The gel strength is the first strength structure of the finished biscuit. On cooling the mixture, for example to room temperature, the temperature falls below the melting point of the fat-lecithin constituent and this constituent solidifies through freezing, producing a second strength structure of the finished biscuit. Presumably, these two strength structures also molecularly interact with one another and this further increases the breaking strength of the biscuit or its resistance to biting.

The high resistance to biting of biscuits according to the invention is only desirable if parts of the biscuit are bitten off by means of the incisors and the first comminuting bites are exerted on the biscuit within the mouth. The subsequent grinding in the mouth to form a bite which is ready to be swallowed should on the other hand, as far as possible, not be hampered by the strength. This apparently contradictory requirement is met by the invention because under the influence of the body heat in the mouth and of the chewing pressure of the molars the biscuit mixture reverts to its thixotropic state in which it is capable of flow. As a consequence, on crushing a biscuit in the mouth, the biscuit does not crumble or disintegrate into lumps or even into powder, but turns into a pleasant tasting paste which can be swallowed.

The consistency of the biscuits is essentially determined by the proportions of the three basic components protein, fat and lecithin. If the lecithin content is increased and the protein content and fat content kept the same, the mixture which is capable of thixotropic flow becomes more fluid and hence, if the lecithin content is high, a high protein content can also be provided at the expense of the fat content. Conversely, the protein content can also be reduced in favour of the fat content, but there are limits to this

due to the initially presented reasons relating to nutritional physiology.

Amongst the vegetable phosphatides mentioned, which are used in conjunction with the invention instead of the crude lecithin obtained from soya beans, or together therewith, it is possible to use cephalin and inositol phosphatides.

By the natural structure of the protein powder there is understood the molecular structure and the spatial helix structure of protein macromolecules. The protein powder cannot be isolated entirely without impairing the natural structure but the invention aims to use as gentle conditions as possible when isolating the protein powder in order to retain as much as possible of the natural structure, which is advantageous for human nutrition.

In isolating the protein powder, for example from milk, the protein powder is obtained mixed with mineral salts and the like unless considerable efforts are made to elute these. However, in the process of the invention this is not necessary. Since the protein is obtained from foodstuffs, the mineral salts and the like which are obtained together with the protein powder are not harmful in human nutrition; rather, they are suitable for use as additives. These mineral salts and the like can be included in the calculation of the additives provided, which then only require to be added separately to the mixture in a correspondingly smaller amounts.

Preferably, because it is outstandingly suitable for human nutrition, the protein employed is milk protein. The milk protein is isolated by drying the dialysis residue of an osmosis dialysis of skimmed milk and/or whey against water, using a dialysis membrane. The membrane is permeable to lactose - and hence also to the salt ions which are present in the milk unless these are hydrated - but is impermeable to milk protein. Flocculation of protein is prevented by adequately maintaining a neutral and sterile medium and by avoiding heating to above 65 degrees centigrade. In this way, milk protein which largely has the natural structure and has the desired high protein content and low carbohydrate content can be isolated on a large industrial scale using simple means. Advantageously, because it is available at attractive prices, the protein employed is vegetable protein. The vegetable protein is

isolated by grinding parts of plants which contain protein. The product is suspended in water to elute the excess carbohydrates, mineral substances and other water-soluble substances. After drying under gentle conditions the suspension residue consists of enriched protein. Parts of plants, containing protein, which can be used are, for example, soya beans, cereal grains, potatoes and the like.

It is advantageous if at least 1/5 of the protein powder employed is milk protein, isolated as described above. It is also advantageous if at least 1/5 of the protein powder employed is vegetable protein, isolated as described above. A combination in which the protein powder employed consists in part of milk powder and in part of vegetable protein is particularly preferred from the point of view of economics and nutritional physiology.

Under certain circumstances additives are only required in small amounts and this, in certain circumstances, produces difficulties in homogeneously distributing the small amounts in the mixture. Sweeteners, for example saccharin and/or cyclamate, and other water-soluble additives such as, for example, vitamins of the B-complex, and trace elements such as iron, manganese and the like can be very simply homogeneously mixed into the mixture. For example they may be incorporated by mixing them into the solution or suspension, containing protein, which is obtained in the manufacture of the protein powder and is already purified. They may then be mixed into the melt conjointly with the dried protein powder.

The mixture can be shaped by extruding it as a band and subsequently cutting the band into the desired biscuit form. However, it is preferably shaped by introducing the finished homogenised mixture, while it still has a thixotropic ability to flow sufficiently for moulding, in individual portions into individual biscuit moulds lined with a smooth wrapping film. The portions are then completely wrapped in the wrapping film whilst simultaneously pressing them into the biscuit mould and moulding and hardening them. The thixotropic ability to flow is maintained by further processing the mixture, which is capable of flow due to having been kneaded, as far as possible by moulding it immediately, so that it has no time to harden in the gel state. If approp-

riate, the pressure required for moulding is chosen sufficiently high that it also prevents the hardening to give a gel. For the same reasons care is taken that the mixture does not cool, prior to the final moulding, to the point that it loses its ability to flow.

In this preferred embodiment, biscuits of greater density can be produced than when moulding as a band. Furthermore, the biscuits moulded in the smooth wrapping film, according to this preferred process, have a smoother surface than those moulded by the extrusion process. The high density and the smooth surface make them more enjoyable to consume.

The invention is illustrated in the Examples, in which all temperatures are in °C.

Example 1

1,400 litres of skimmed, sterile cow's milk at 60° are dialysed by dialysis against singly distilled water until the sugar content has been reduced to 20 per cent by weight relative to the solids and the mineral salt content has been reduced to 6 per cent by weight relative to the solids. The dialysate is concentrated to 200 litres by evaporation in vacuo at 60°. 48 grams of sodium saccharin are stirred into the concentrated solution, containing protein, and this solution is then spray-dried whilst keeping the temperature of the solids below 50°. The dry residue obtained consists of 56.6 kilograms of protein powder of which the protein has been left in its natural structure. The protein powder has a protein content of 70 per cent by weight, a lactose content of 20 per cent by weight, a salt content, of calcium salts, potassium salts and phosphorus salts, totalling 6 per cent by weight, and contains about 0.12 per cent by weight of saccharin, the remaining percentage by weight being water.

30 kilograms of coconut fat of chain length C 12 to C 18, melting at 36°, are introduced in the molten state into a kneader equipped with a heat-insulated kneader jacket. This melt is warmed to 43° and 1.5 kilograms of crude lecithin obtained from soya beans are stirred into the warm melt. The mixture is stirred for 5 minutes by means of the kneading tools of the kneader. 5 kilograms of freeze-dried ripe strawberries granulated to a particle size

of at most 2 millimetres are introduced into this mixture, and the mixture is stirred for 5 minutes by means of the kneading tools. Into this mixture are mixed 40 kilograms of protein powder and half a kilogram of an oily solution containing: 13.6 g of vitamin A acetate (1.5 million international units per gram); 3.5 g of vitamin D3 (0.4 million international units per gram) and 73.5 g of vitamin E acetate, the remainder being edible oil. The remaining 16.6 kilograms of protein powder are mixed with 1.3 kilograms of citric acid which is free of water of crystallisation, 95 g of vanillin, 3 g of vitamin B1, 3.8 g of vitamin B2, 5.7 g of vitamin B6, 13.3 milligrams of vitamin B12, 38.2 g of nicotinic acid amide, 200 g of vitamin C, 24.4 g of calcium panthothenate and 2.5 g of folic acid, and then stirred into the mixture contained in the kneader. The mixture produced in the kneader is rendered thixotropically capable of flow, and homogenised by kneading whilst maintaining a temperature of 35° and is moulded, whilst still capable of flow and maintaining a temperature of 35°, to give an approximately 10 millimetres thick and 50 millimetres broad band which is then cooled to 23°. 24 millimetre long sections are cut from the cooled band as parallelepiped biscuits which are then consolidated by further cooling to room temperature of 20° and waiting for one hour. The consolidated biscuits are wrapped in an internally waxed metal foil.

The biscuits obtained in this manner can be broken and chewed at a room temperature of 20°. They weigh 7 grams per piece and have a density of 0.75 grams/cm^3 ± 5%. Such a biscuit weighing 7 grams contains 40% of protein, 33% of coconut fat, 1.7% of crude lecithin and 12% of lactose, the remainder being mineral salts, vitamins, saccharin and granulated strawberries.

Example 2

The procedure of Example 1 was followed except that the moulding of the mixture is not carried out in a band but by introducing the finished homogenised mass, at a temperature of 32°, in individual portions of 7 grams each into individual biscuit moulds which are open at the top and are lined with a wrapping film. The biscuit mould consists of a parallelepiped cavity of 24 millimetres width and 54 millimetres length which is open at the top over its entire outline. In this biscuit mould, the portion is completely wrapped

in the wrapping film and at the same time compressed by a punch which fits into the opening of the biscuit mould to give a parallelepiped biscuit of size approximately 24 x 50 x 10 millimetres. The wrapping film consists of aluminium and is smooth and waxed-coated on the inside which comes into contact with the biscuit. The wrapped biscuit is taken out of the biscuit mould and hardened to a chewable state by cooling to a temperature of 20° and waiting for one hour.

The composition of the biscuits obtained and their sizes are the same as for the biscuits obtained according to Example 1, the sole difference being that the biscuit surface has the smoothness of the solidified coconut fat employed on all its sides and that the density is greater, namely 0.78 grams/cm^3 ± 5 %. This greater density assists the desired ability of the biscuit to be chewed. As a result of the great smoothness, the flavour of the biscuits is improved.

Example 3

Like Example 1, with the sole difference that instead of 56.6 kilograms of protein powder obtained from skimmed cow's milk, 14.14 kilograms of protein powder obtained from skimmed cow's milk and 42.45 kilograms of protein powder obtained from wheat are employed. The protein powder is obtained from wheat as follows: 240 kilograms of flour from wheat grains are suspended in 1,000 litres of water. Elution reduces the carohydrate content of the washed material to 10 per cent by weight relative to solids and the mineral salt content to 5 per cent by weight relative to solids. The washed material is dried under gentle conditions and 42.45 kilograms of wheat protein powder containing 85% of protein are obtained. The biscuits, otherwise manufactured according to Example 1 have a slightly different composition in accordance with the different carbohydrate and mineral substances content. The density of the solidified biscuits is 0.9 gram/cm^3 ± 5 %.

Example 4

The procedure followed was that of Example 1, except that instead of the 56.6 kilograms of protein powder obtained from skimmed cow's milk 14.14 kilograms of protein powder obtained from skimmed cow's milk and 42.45 kilo-

grams of protein powder obtained from soya beans, containing 85 per cent of protein, are employed.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. Process for the manufacture of biscuits that comprises (i) melting together (a) 1 part by weight of edible fat which melts in the range of 28 to 40°C, and (b) 0.03 to 0.2 part by weight of crude lecithin obtained from soya beans and/or vegetable phosphatides chemically related thereto; (ii) mixing into the melt (c) 1.5 to 4 parts by weight of dry powdered protein obtained from foodstuffs, with a protein content raised by purification to at least 60 per cent by weight - relative to solids - and concentrated to a carbohydrate content of 5 to 35 per cent by weight-relative to solids - and has as far as possible been left in its natural structure and (d) a total of 0.1 to 1 part by weight - relative to solids - of additives containing mineral salts, flavouring substances and/or vitamins; (iii) rendering the mixture thixotropically capable of flow and homogeneous by kneading whilst warming to a temperature of 28 to 50°C; (iv) shaping the mixture whilst still capable of flow and (v) hardening the mixture by leaving it to stand whilst cooling.

2. Process as claimed in claim 1, in which the edible fat is coconut fat melting at 36°C and having a chain length of C 12 to C 18; the crude lecithin is obtained from soya beans and is used in the amount of 0.05 parts by weight; the dry powdered protein is milk protein used in the amount 1.5 to 2 parts by weight and with a protein content of 65-70 per cent by weight - relative to solids - and a lactose content of 20 to 25 per cent by weight - relative to solids and the kneading temperature is 28° to 35°C.

3. Process as claimed in claim 1 in which at least 1/5 of the protein powder employed is milk protein obtained by drying the dialysis residue of an osmosis dialysis of skimmed milk and/or whey against water, using a dialysis membrane which is permeable to lactose but is impermeable to milk protein, whilst preventing the flocculation of protein by maintaining a neutral and sterile medium and by avoiding heating to above 65°C.

4. Process as claimed in claim 1, 2 or 3, in which at least 1/5 of the protein powder employed is vegetable protein obtained by grinding parts of

plants which contain protein, suspending the product in water, eluting excess carbohydrates, mineral substances and other water-soluble substances from this suspension and drying the suspension residue, which consists of enriched protein, under gentle conditions.

5. Process as claimed in any one of claims 1 to 3, in which sweeteners and/or other water-soluble additives are homogeneously mixed into the composition by mixing them into a purified solution or suspension containing protein obtained in the preparation of the protein powder, the additives being mixed into the melt conjointly with the dried protein powder obtained therefrom, in which they are present in a homogeneously distributed form.

6. Process as claimed in any one of claims 1 to 3, in which the finished homogenised mixture is introduced, whilst maintaining a sufficient thixotropic ability to flow for moulding, in individual portions into individual biscuit moulds lined with a smooth wrapping film and these portions are then completely wrapped in the wrapping film whilst simultaneously pressing them into the biscuit mould, and moulded and hardened.

7. A biscuit that can be chewed so as to break at room temperature, the biscuit being in the form of a thixotropically consolidated gel of which the dispersing agent has also solidified on cooling, the biscuit containing the following homogeneously distributed: per 1 part by weight of edible fat melting in the range of 28 to 40 degrees centigrade: 0.03 to 0.2 part by weight of crude lecithin obtained from soya beans and/or vegetable phosphatides chemically related thereto, 0.9 to 2.4 parts by weight of protein, at most 1.4 parts by weight of carbohydrate and a total of 0.1 to 1 part by weight of additives, containing nutrient salts, flavouring substances and/or vitamins.

8. A biscuit as claimed in claim 7 that contains 1 part by weight of coconut fat of chain length C 12 to C 18, melting at 36 degrees centigrade, 0.05 part by weight of crude lecithin obtained from soya beans, 1.0 to 1.4 parts by weight of milk protein, 0.3 to 0.5 part by weight of lactose and a total of 0.1 to 1 part by weight of additives.

9. A biscuit as claimed in claim 7 or claim 8 having a density of 0.78 g / cm^3 ± 5 %.